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1.2 On the Variation of Ochrolechia parella in the Western Antarctic and Subantarctic Area

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Zusammenfassung: Es wurden Flechtensäuren, Anzahl und Größe der Sporen und Größenverteilung der Apothetien untersucht. Das Material läßt sich in zwei Gruppen bezüglich Anzahl und Größe der Sporen aufteilen: die erste Gruppe mit vier Sporen, die zweite Gruppe mit acht etwas kleineren Sporen.
Die Größenverteilung der Apothetien zeigt drei Typen: 1. mit normaler Verteilung, 2. mit breiter Verteilung und 3. einer Kombination aus beiden. Das Material enthielt Gyrophorsäure, Variolarsäure und Alectoronsäure, aber es ergibt sich keine Korrelation mit den anderen untersuchten Charakteristiken. *O. deceptionis* (Hue) Darb. ist nur eine Varietät von *O. parella* während *O. antarctica* (Müll. Arg.) Darb. mit *O. parella* synonym ist. Aspekte der sexuellen Reproduktion und des Verlustes von Photosynthesekapazität durch die Produktion von Apothetien werden diskutiert.

Summary: Secondary chemistry, spore number and size, and size distribution of apothecia are investigated. The material can be divided into two groups defined by the number and size of spores: one group with four spores and one group with eight, somewhat smaller spores. Apothecium size distribution can be assigned to three types: one with normal distribution, one with a flat distribution, and one interpreted as a combination between the first two. The material contained gyrophoric acid, variolaric acid and alectoronic acid, but there is no correlation with the other characters investigated. *O. deceptionis* (Hue) Darb. is reduced to a variety of *O. parella*, while *O. antarctica* (Müll. Arg.) Darb. is placed in synonomy with *O. parella* Aspects of sexual reproduction and photosynthetic loss by apothecium production are discussed.

1. INTRODUCTION

In the western Antarctic and Subantarctic area, saxicolous specimens of the lichen genus *Ochrolechia* appear to be rather common. Two species have been described from this area, and a third, described from Northern Europe, has been reported from the same area. The species are closely related, and this paper is mainly an attempt to clarify their taxonomy.

2. MATERIAL AND METHODS

The material comprises ca. 20 specimens, and secondary chemistry, size distribution of apothecia,number of spores and size of spores have been used in the treatment. The spore size was measured in a 10% KOH aqueous solution. TLC analyses were performed in accordance with standard methods (CULBERSON 1972, MENLOVE 1974).

3. RESULTS

3.1. *Secondary chemistry.*

Three main compounds occurred: gyrophoric acid (found only in apothecia), variolaric acid and alectoronic acid.

3.2. *Spore number and size*

3.2.1. Spore number.

There were two groups in the material. One group had eight well-developed spores in the asci, while the other had four well-developed and remains of four aborted spores in the asci.

3.2.2. Spore size

Length of spores varied from about 60 to about 100 µm (Fig. 1). Spores from asci with four well-developed spores were on average, larger than spores from asci with eight well-developed spores.

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3.3. *Size distribution of apothecia*

Most specimens could be placed in either of two categories of size distribution of apothecia (Fig. 2). One category could be described as a bell-shaped distribution, while the other could be described as a flat distribution.

4. DISCUSSION

Ochrolechia parella (L.) Massal. is a fairly common species on maritime rocks in Northern Europa. It has a thick, white crustose thallus, and usually has abundant 2—4 mm broad apothecia with a broad thalline margin and 8 spores in the asci. This taxon has been reported from the Antarctica area by LINDSAY (1971), and the specimen matches well with Northern European specimens. Two other closely related taxa have been described from the region: *O. deceptionis* (Hue) Darb. from Deception Island, and *O. antarctica* (Müll. Arg.) Darb. from South Georgia. The holotypus of *O. deceptionis* (PC) is almost completely covered by apothecia. Mean diameter size and standard deviation of apothecia (n=12) are 1.8 ±0.3 mm. The apothecia are often angular due to crowding, the thalline margin is thin and about 0.2 mm in mature apothecia, and the disc is usually cracked and slightly more brown than the margin which is similar in colour to the thallus. No mature spores were seen, but according to the protologue it is fourspored. The TLC-analysis showed gyrophoric and variolaric acids. The holotype of *O. antarctica* (M) has two unripe apothecia with ± pore-formed discs, and one mature apothecium with a flat, well-developed disc with a diameter of 1.7 mm. According to the protologue, it is four- to eight-spored. The TLC-analysis showed variolaric acid (only thallus tested).

In earlier treatments of these taxa, size and number of spores and size of apothecia were considered particular diagnostic characters (VERSEGHY 1962, LINDSAY 1971). In the present material, the specimens showed a high constancy in spore number, and only in one specimen (from South Georgia) was any variation in spore number found. In the closely related genus *Pertusaria*, Dibben (1980) found no constancy in spore number in three of 66 investigated North American species. In this case the absence of constancy may well be genotypically determined, but other cases are reported where it appears that absence of stability is phenotypically determined (cf JØRGENSEN et al. 1983).

The spore size of the specimens investigated here is fairly closely correlated with the number of spores in asci (Fig. 1), simply because when the number of spores is reduced, there is more room for the remaining, ripe spores in asci of the same size. Figure 1 also shows that there is no discontinuity in the spore size material, even if the mean size of spores from four-spored specimens is larger than that from eight-spored specimens.

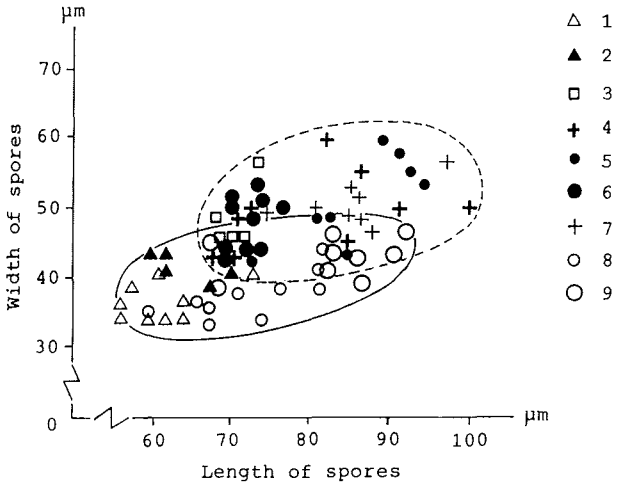

Fig. 1: Spore size of 8 specimens of *Ochrolechia parella* from the western Antarctic and Subantarctic area and Falkland islands, and one specimen from Norway. One apothecium was investigated from each specimen. Each score represent a spore from an individual ascus. Full line: eight-spored specimens; broken line; four-spored specimens.
1: Falkland islands, Op. Tabarin no 2995 (BM)
2: Falkland islands, Op. Tabarin no. 2869 (BM)
3: South Shetland Islands, Livingston island, Lindsay no. 349 (AAS)
4: South Shetland Islands, Greenwich island, Lindsay no. 700a (AAS)
5: South Orkney Islands, Signy island, R. I. L. Smith no. 431 (AAS)
6: South Shetland Islands, Deception island, R. I. L. Smith no. 3661 (AAS)
7: South Shetland Islands, Livingston island, Lindsay no. 513 (AAS)
8: Falkland islands, Lindsay no. 1668 (AAS)
9: Norway, Hordaland, Stord, Gullberget, Havaas leg (s.n.) (BG)

The largest apothecium of each of the types of *O. deceptionis* and *O. antarctica* have, respectively, a diameter of 2.5 and 1.7 mm. In neither case is the material sufficient for statistical analysis. The apothecia of Northern European *O. parella* may have a diameter up to 4 mm (own observations). To get a more sound basis for the interpretation of apothecium size, a number of size distributions were studied. Three selected distributions are presented in Figure 2. In the case A, a bell-shaped distribution is found, statistically reminiscent of a normal distribution. The strategy behind this may be explained as follows: a mature thallus starts development of all apothecia at the same time. Among these apothecia, some will grow well, and others less well, and they will produce sizes following a normal distribution. Such a strategy may be advantageous when the specimen lives in a harsh environment, with short spells of better conditions, which the specimen can take advantage of for its apothecium production. The distribution B (Fig. 2) has about the same number of apothecia in each size class. This may happen when new apothecia are produced continously, and may be called a „safety-first" strategy. A third type of distribution, C, may be described as an inverted J. This is a kind of age/size distribution often found in higher plants, but in that case it is usually explained as a result of high mortality rate. In these lichens, I could not observe any mortality among the apothecia, so its cause has to have some other reason. It may be explained as a combination of the two already mentioned strategies; a constant, safety first strategy with the addition of a recent outburst of apothecium production. But it is obvious that apothecium initiation and growth are complex and cannot be used in taxonomic treatments without thorough field investigations.

There was no discontinuity in the distribution of the size of the largest apothecia.

As to the secondary chemical compounds, two groups were found. One group had gyrophoric and variolaric acids, while the other had alectoronic acid in addition. This is in accordance with what is found in European specimens (HANKO et al. 1985). However, no correspondance with these two groups and spore number or geographical distribution was found.

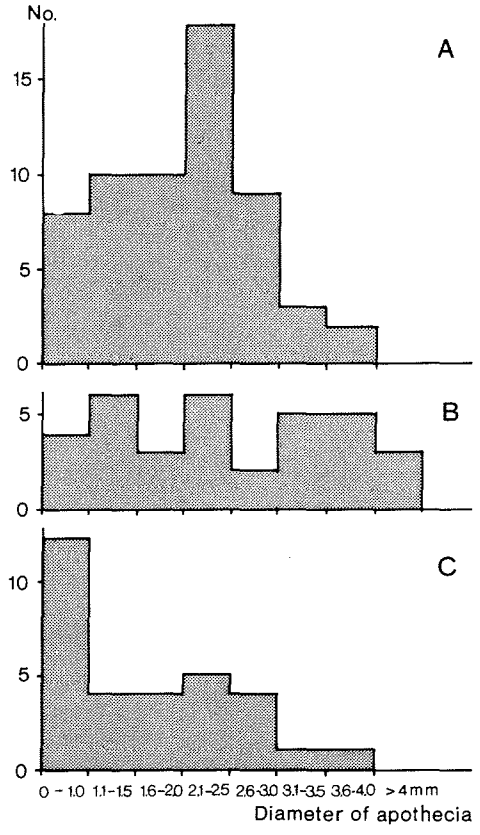

Fig. 2: Distribution of apothecium diameters from three selected specimens of *Ochrolechia parella*.
A: Falklands islands, Op. Tabarin 2869 (specimen I) (BM)
B: Falkland islands, Op. Tabarin no. 2998 (BM)
C: Falkland islands, Op. Tabarin no. 2869 (specimen II) (BM)

The conclusion is that there appears to be no discontinuity in the material except for one main character: number of spores. The specimens with four-spored asci are all found in the South Orkney and South Shetland area (Fig. 3). *O. deceptionis* is based on such a specimen, but with a difference in only one main character from *O. parella*, it cannot be maintained as a species and it is reduced to a variety of that species: *O. parella* var. *deceptionis* (Hue) Øvst. comb.nov (basionym *Lecanora deceptionis* Hue 1915: 93). *O. antarctica* must be reduced to a synonum of *O. parella*.

Two aspects of lichen biology should be mentioned; the photosynthetic part lost by apothecium production, and reproduction by means of spores. The thallus of *Ochrolechia parella* has algae 70 to 100 µm below the cortex, but also in the thalline margin of the apothecia and below the hymenium. However, the algal layer below the hymenium is thinner than that in the medulla, and preliminary results show that the replacement of thallus with apothecia reduces the photosyntetic tissue by about 30%. This may be an important, but not an extreme, reduction in photosynthetic tissue.

Ochrolechia parella is most probably able to reproduce sexually, as it apparently produces ripe spores. Usually it has been assumed that lichen spores must germinate and meet a specific algal partner very soon afterwards to produce the symbiosis. The algae of *O. parella* are trebouxoid, probably belonging to the genus *Trebouxia*, and if these algae exist in a free-living state on rock under such harsh enviroments as in the Antarctic, they are probably

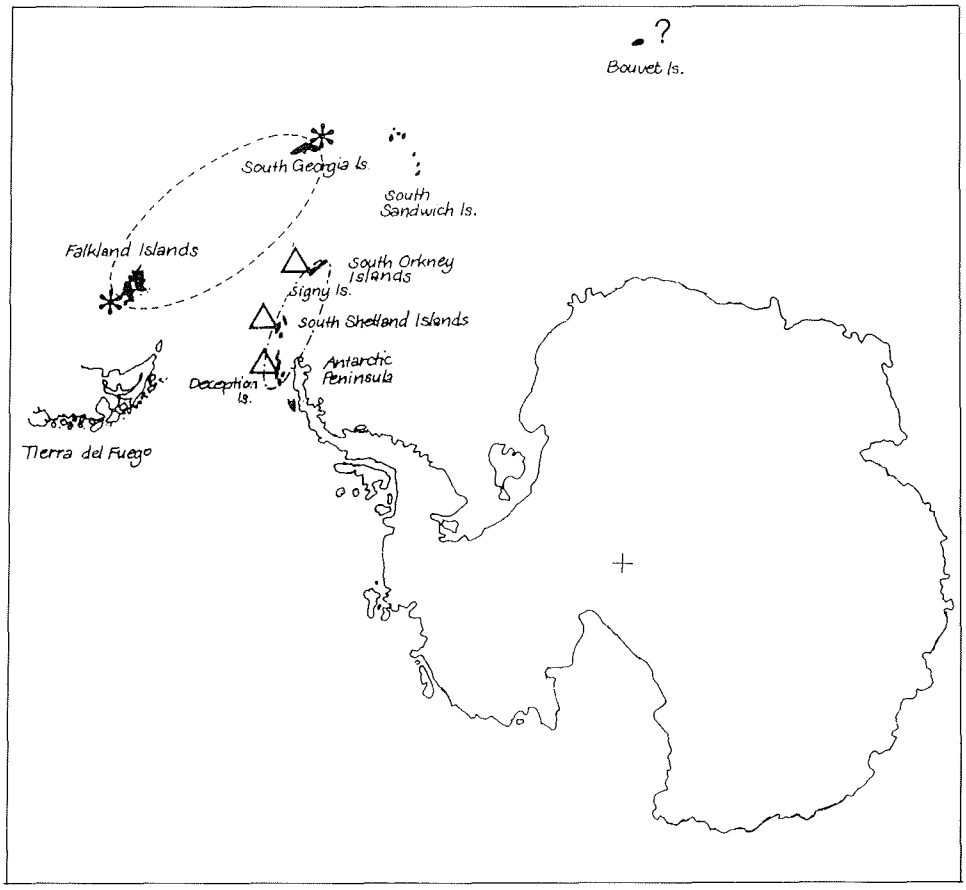

Fig. 3: Geographical distribution of *Ochrolechia parella* in the western Antarctic and Subantarctic area, and on the Falkland islands. Star: eight-spored populations. Triangle: four-spored populations

rare. However, there is the possibility that small, loose thallus parts or diaspores from the same or other lichen species may be the source for the relichenization (HALE 1974, OTT 1987). Another possibility, which has just recently been proposed is that the fungus associates with other algae and eventually relichenizes with the correct lichen partner (OTT 1987). In a reproductive context, it is interesting to note that the only major difference in the present material is spore size, a character which must be important for spore germination and early development of the hyphae.

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